Multi-scale Methane Analytic Framework (M2AF)

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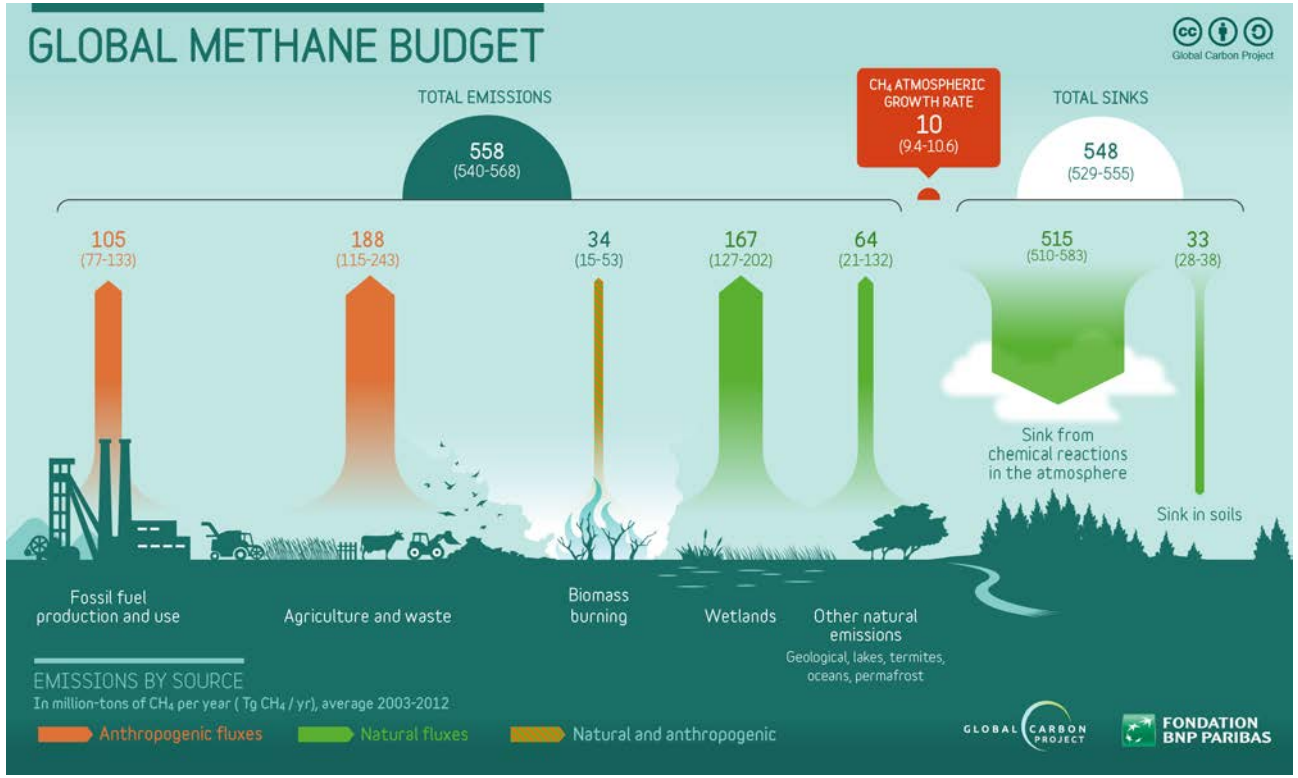
Program: AIST-18

(please see the PowerPoint notes section below for some tips)

Problem to Solve

- Methane is #2 anthropogenic climate forcing agent and ozone precursor
- ~34-86x global warming potential of CO2 on 100 and 20 yr horizons
- Large uncertainties (50% to unknown) across many scales
- Growth rate incompatible with greenhouse gas goals and causes poorly understood



Tiered Observing Strategy and Need for Tiered Analysis Strategy

(1) Satellites: Global mappers and point source mappers

(2) Regional & local surface in-situ networks (towers)

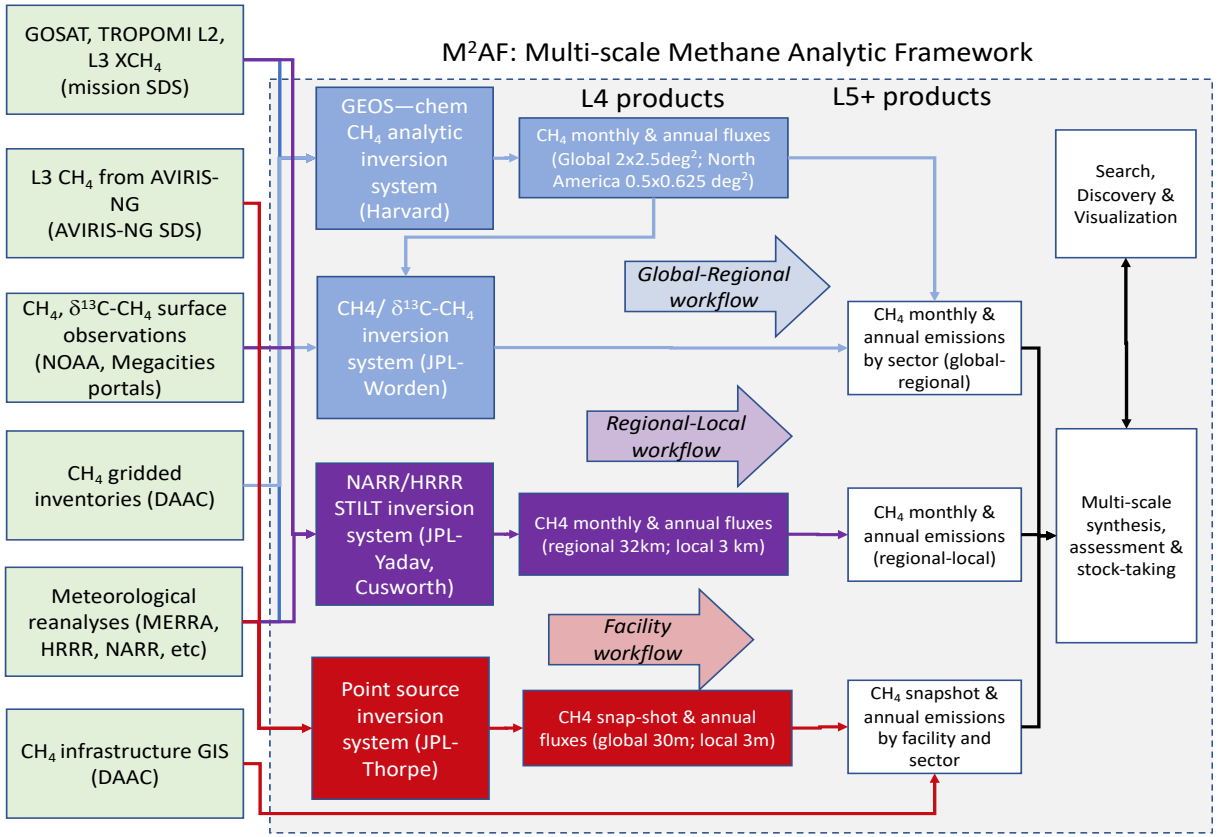
(3) Airborne surveys: Local-regional net fluxes & point-source mappers

(4) On-site and on-road surveys

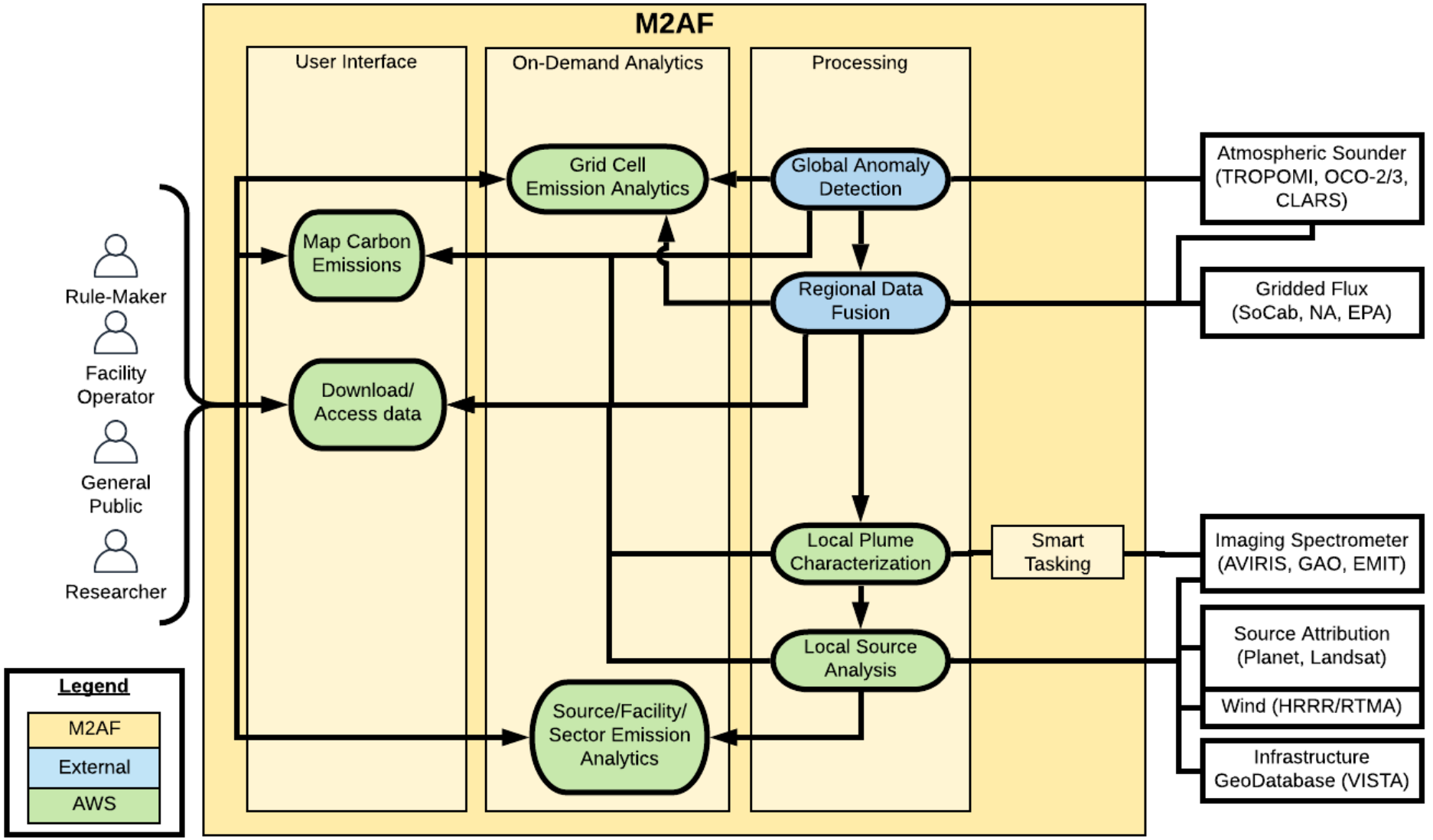
Solution: M2AF

Objectives:

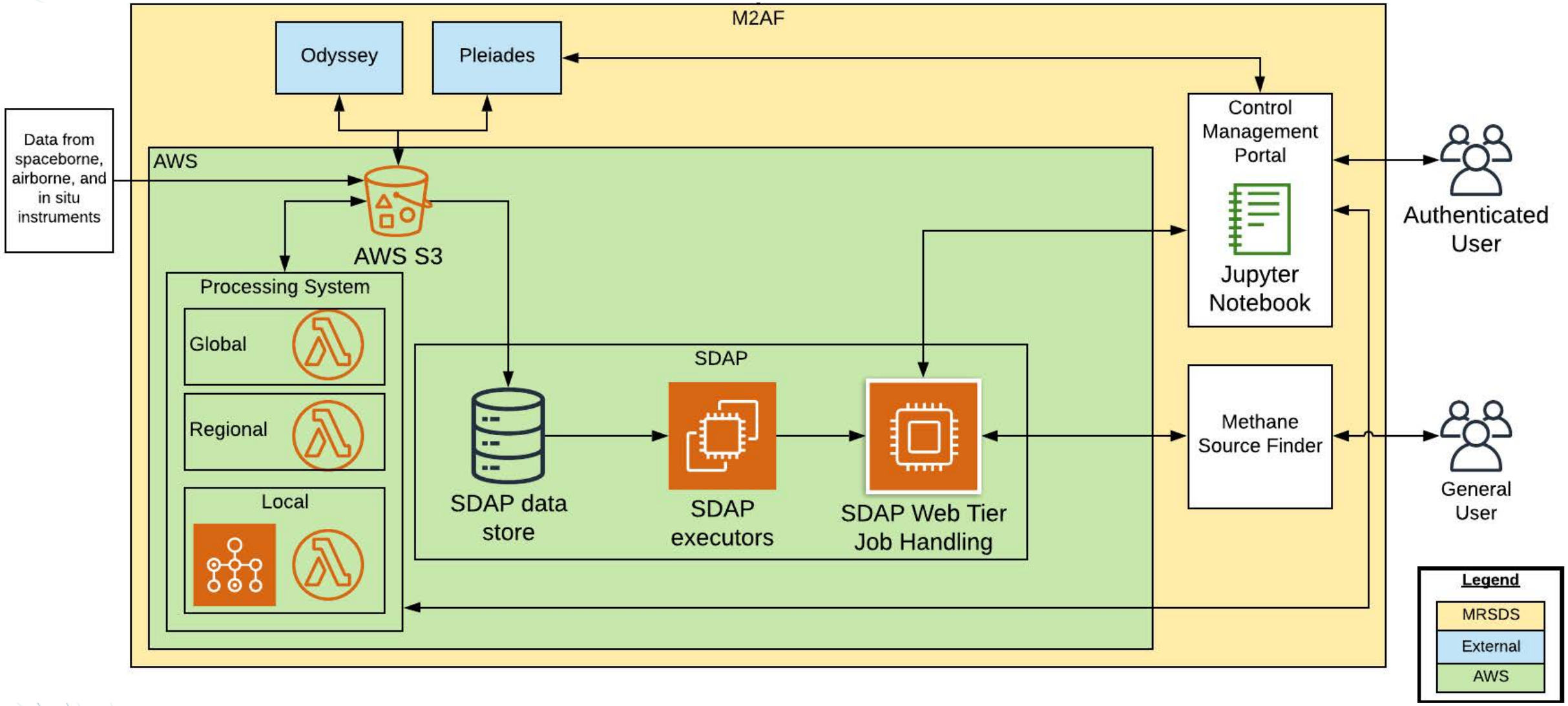
- Improve component workflows to reduce methane data product (Levels 4 and 5) latency and integrate common core functions
- Create new tools for on-demand analytics including fusion across multiple products and spatial scales
- Improved data search, discovery and visualization capabilities of Methane data



Technical Details: Use Cases



Technical Details: Architecture



Next Steps / Contributions

- We have begun development in AWS
- First System test is at the end of FY20
- Publication on multi-tiered observation approach used in M2AF

Geophysical Research Letters

RESEARCH LETTER
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Key Points:
- A multitiered (surface, airborne, mountaintop, and satellite) methane tiered observing system is created for the Los Angeles Basin
- Combining multiple observing system into a single framework allows for increased spatial and temporal sensitivity to methane emissions
- Inverse fluxes from the multitiered system over a large landfill are validated with independent airborne observations

Supporting Information:
- Supporting Information S1

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Synthesis of Methane Observations Across Scales: Strategies for Deploying a Multitiered Observing Network

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Abstract Regional methane emissions monitoring is rapidly expanding with increased coverage of surface, airborne, and satellite instruments. We pilot a multitiered observing system in the Los Angeles Basin. We combine surface methane measurements from the Los Angeles Megacities Carbon Project, mountaintop retrievals from the CLARS-FTS instrument, and space-based X_{CH4} retrievals from the TROPOMI instrument into a single monitoring framework. We simulate these observations using a high-resolution tracer transport model. Using inverse methods, we compare the sensitivity of each observing system component to various emissions sources. Combining multiple observing system into one framework allows for increased spatial and temporal sensitivity to methane emissions. We find a close correspondence between these inverse flux trends and independent airborne AVIRIS-NG methane plume trends over a large landfill in the Los Angeles Basin. These results show that multitiered observing systems can reveal insights about sub-basin scale methane emissions, which can be used to drive decision support.

Plain Language Summary Methane is a powerful greenhouse gas. In order to effectively reduce its atmospheric concentrations, we need advanced methane observing strategies to pinpoint large emissions on small spatial scales. In this study, we combine surface, mountaintop, and satellite observations of methane over Los Angeles (called a multitiered observing system) and use these data to infer information about urban methane emissions. We assess how much information each component of the observing system provides to this analytics system. We validate our findings with independent airborne methane fluxes derived from the AVIRIS-NG airborne instrument over a large landfill. Both systems detected large emission reductions that resulted from improved management practices. A multitiered observing and analytics system can potentially provide sub-basin scale decision support for methane mitigation.